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ABSTRACT

The role of the instructor in computer-based training (CBT) has not been previously studied. However, the role of instructor in traditional instruction (TI) has been studied and has been shown to influence student achievement. A key finding from TI research is that instructor-student interaction is positively related to achievement. This investigation varied instructor-student interaction (present/absent) in a CBT setting. Subjects (15 female and 10 male college students) worked a spreadsheet tutorial and then were asked to use the spreadsheet to compute statistical values. The results show that both interaction and no-interaction subjects equally understood the spreadsheet commands, but that those subjects who received instructor interactions scored higher on actually using the commands to compute statistical values. Low-ability subjects appear to benefit most from instructor interaction. One table presents means and standard deviations for performance. (Contains 15 references.) (Author/SLD)

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THE EFFECT OF INSTRUCTOR-STUDENT INTERACTION ON ACHIEVEMENT IN COMPUTER-BASED TRAINING (CBT)

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The role of the instructor in computer-based training (CBT) has not been studied. However, the role of the instructor in traditional instruction (TI) has been studied and has been shown to influence student achievement. A key finding from the TI research is that instructor-student interaction is positively related to achievement. This investigation varied instructor-student interaction (present/absent) in a CBT setting. Subjects (Ss) worked a spreadsheet tutorial and then were asked to use the spreadsheet to compute statistical values. The results showed that both interaction and no-interaction Ss equally understood the spreadsheet commands but that those Ss who received instructor interactions scored higher on actually using the commands to compute statistical values. Low-ability Ss appeared to benefit most from instructor interaction.

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PREFACE

This paper summarizes the initial investigation into the role of the instructor in CBT. This research was conducted under the United States Air Force Summer Faculty/Graduate Student Research Program and was sponsored by the Air Force Office of Scientific Research/AFSC, United States Air Force, under contract F49620-88-C-0053. The author would like to thank the Armstrong Laboratory's Human Resources Directorate (AL/HRD) and in particular the Technical Training Research Division for providing an environment supportive of this work. Several AL/HRD individuals were of specific help: Colonel Rodger Ballentine and Drs. Scott Newcomb, Hendrick Ruck, and Wesley Regian. To the remainder of the Division and to the Library staff, thanks for all of your assistance.

THE EFFECT OF INSTRUCTOR-STUDENT INTERACTION ON ACHIEVEMENT IN COMPUTER-BASED TRAINING (CBT)

SUMMARY

The role of the instructor in computer-based training (CBT) has not been studied. However, the role of the instructor in traditional instruction (TI) has been studied and has been shown to influence student achievement. One of the key findings from the TI research is that instructor-student interaction is positively related to achievement. The present investigation varied instructor-student interaction (present/absent) in a CBT setting. Subjects worked a spreadsheet tutorial and then were asked to use the spreadsheet to compute statistical values. The results showed that both interaction and no-interaction Ss equally understood the spreadsheet commands but that those Ss who received instructor interactions scored higher on actually using the commands to compute statistical values. Low-ability Ss appeared to benefit most from instructor interaction. The results were discussed both in terms of past research and in terms of helping to define the role of the CBT instructor.

I. INTRODUCTION

Computer-based training (CBT) research has typically focused on comparing a CBT course with a corresponding traditional instruction (TI) course. Compared to a similar TI course, CBT generally, but not always, produces increases in learning and retention while concurrently requiring less time than TI (Fletcher & Rockway, 1986; Goodwin, Goodwin, Nansel, & Helms, 1986; Kulik & Kulik, 1986, 1987; McCombs, Back, & West, 1984; O'Neil, 1986). However, CBT results have not always been positive; there are instances in which CBT did not produce increases in performance or decreases in learning time (Goodwin et al., 1986; McCombs et al., 1984).

In general, there has been little research on maximizing performance within a CBT system (Gillingham & Guthrie, 1987). Conversely, there is a long history of research on variables that influence achievement in TI systems. One of the most researched variables is instructor behavior. TI research has produced a relatively high degree of consensus as to what an effective instructor does versus what a not-so-effective instructor does, with "effective" being defined in terms of academic achievement (Brophy, 1986; Brophy & Good, 1986; Rosenshine, 1983). Yet CBT research has neglected the role of the instructor (Moore, 1988). Little is known about whether or not TI instructor variables transfer to CBT.

In a study that did examine the role of the CBT instructor, Moore (1988) found that students who had teachers with positive attitudes scored higher than those in classes with teachers with negative attitudes. In a review of CBT studies, McCombs et al. (1984) found that two factors were critical to the success of the CBT courses: (a) adequate opportunities for student-instructor interactions, and (b) the incorporation of group activities with individualized training.

The instructor-student interaction requirement noted by McCombs et al. (1984) is a significant finding in that one of the most consistently reported positive TI instructor behaviors is frequent but short instructor-student interactions; i.e., an increase in instructor-student interactions produces an increase in achievement (Brophy, 1986; Brophy & Good, 1986; Rosenshine, 1983). Therefore, a TI instructor behavior which may transfer to CBT is instructor-student interaction.

The purpose of the present effort was to examine the effect of instructor-student interaction in CBT. Based on the TI instructor literature, it was hypothesized that increased instructor-student interaction would produce increased achievement.

II. METHOD

Subjects

The subjects were 25 (15 female and 10 male) college juniors and seniors enrolled in a Business Statistics class. As part of a project designed to teach students how to use computer spreadsheet software to perform statistical computations, Ss volunteered to participate in a spreadsheet tutorial for extra credit. The extra credit was awarded for project completion, not for project performance. All Ss completed a survey to assess their previous personal computer (PC) experience.

Experimental Materials

The spreadsheet tutorial was part of a larger commercial software tutorial package designed for an integrated spreadsheet-word processing-database program. The tutorial is linear and learner-controlled; however, Ss do have the capability to repeat a lesson if desired.

For the purposes of this study, the larger tutorial was modified to include only the introduction to the integrated package plus that portion of the tutorial software devoted to the use of the spreadsheet. The introduction portion (Part A) contained four lessons, and the spreadsheet portion (Part B) contained eight lessons. The tutorials were run on Tandy 1000SX PCs.

An exercise designed to evaluate mastery of the spreadsheet tutorial commands was added to the experimental software. Because the Ss were volunteers from a Business Statistics class, the exercise used simple statistical calculations as the vehicle for evaluating spreadsheet mastery. Consequently, the experimental material consisted of a CBT spreadsheet tutorial modified to include a statistics-based exercise. The statistics exercise was also run on a PC.

Procedure

Ss were randomly assigned by spreadsheet/PC experience to one of two instructor-student interaction modes. Group I (n=13) had no instructor-initiated interactions. All Group I interactions were initiated by the student and consisted of requests by the students for help in overcoming an obstacle in the tutorial. Group II (n=12) experienced the same type of student-initiated interactions as those experienced by Group I. In addition, Group II was exposed to multiple instructor-initiated interactions. Ss worked individually on both the tutorial and the statistics exercise.

Both groups worked the CBT tutorial in three sessions. In session one, all Ss started on lesson A1 and worked in the tutorial for 90 minutes. In the second session, all Ss started on lesson B1 and worked through the last lesson, B8. In the third session, all Ss started on lesson B3 and again worked through the last lesson, lesson B8. Consequently, all Ss had a single exposure to lessons A1 though A4 and repeated exposure to lessons B1 through B8. Because each S went at his/her own speed, Ss' total time on task varied. At the completion of lesson B8 on day 3, all Ss were given the statistics exercise designed to evaluate their mastery of the tutorial material. Ss had 30 minutes to work on the exercise.

During the start-up period of the project (i.e., the first 15 minutes of the first session), the instructor responded to all questions in both groups to ensure that the Ss were properly logged into the tutorial. For both groups, the instructor also responded to all student-initiated interactions with one or more of three responses: (a) "Try pushing the [ESCAPE] key"; (b) "Try pushing the [SPACE] bar"; or (c) "Re-boot the system and start over." These suggestions were given in sequence (e.g., if "Try pushing the [ESCAPE] key" did not work, the S was told to "Try pushing the [SPACE] bar.") For Group I Ss, these suggestions were the only instructor interactions experienced after the first 15 minutes of session one.

In addition to the interactions listed above, Group II Ss also experienced instructor-initiated interactions. In the first session, the instructor initiated four interactions with each S. In sessions two and three, the instructor initiated three interactions and one interaction, respectively. These interactions were related to the location of keys on the Tandy keyboard (e.g., shortly before needing to use the Back Slash (\) key, the instructor would tell the Group II Ss where that key was located.) Key location was explained and diagrammed in instructions given to all Ss; but for most Ss, key location on the Tandy keyboard was a minor problem due to previous exposure to an IBM keyboard. Instructor-initiated interactions lasted between 5 and 10 seconds.

It should be noted that in no instance did the instructor provide information that was not available to the Ss elsewhere. Also, in no instance did the instructor comment, provide feedback, or give praise on the Ss' performances on the tutorial.

Dependent Measures

Two dependent measures were recorded. First, the Ss' performance on the exercise was scored. Second, Ss also recorded which spreadsheet commands they used. Because most procedures can be performed in more than one way (e.g., a cell entry can be changed via an EDIT command or by simply retyping the entry), this second measure was recorded to assess how many different commands were actually used during the exercise.

III. RESULTS

Means and standard deviations for Spreadsheet Performance and Use of Spreadsheet Commands are given in Table 1. Due to the small sample sizes (and possible problems with the assumption of normality), the Mann-Whitney U non-parametric test statistic was used to analyze differences between Group I (no instructor-initiated interaction) Ss and Group II (instructor-initiated interaction) Ss.

Table 1. **Spreadsheet Performance and Use of Spreadsheet Commands: Means and Standard Deviations**

		Spreadsheet Performance	
		Mean	**SD**
Group I	(No Interaction)	58.000	18.257
Group II	(Interaction)	72.417	7.403
		Use of Spreadsheet Commands	
Group I	(No Interaction)	32.308	7.250
Group II	(Interaction)	30.833	8.483

Exercise Performance

Group II (instructor-initiated interaction) Ss significantly outperformed Group I (no instructor-initiated interaction) Ss (Mann-Whitney U = 34.50, $p < .017$).

Use of Spreadsheet Commands

There was no difference in command usage between Group I Ss and Group II Ss; (Mann-Whitney U = 82.00, $p < .824$).

Sex Differences

Performance differences between male and female Ss were not significant (for Spreadsheet Performance, Mann-Whitney U = 56.00, $p < .289$; for Use of Spreadsheet Commands, Mann-Whitney U = 69.50, $p < .755$).

IV. DISCUSSION

The hypothesis that increased instructor-student interaction would lead to increased achievement was supported. Given the limited length of the CBT program used in this experiment, the degree of difference of increased achievement between the two groups was surprising. For some reason, having the instructor interact with/take notice of/care about a student affected the student to the point where it increased his/her achievement. The underlying cause for the difference in achievement did not seem to be knowledge; all Ss seemed to equally use the commands presented in the tutorial. The difference was in how well the commands were used.

Nor was the difference in achievement due to praise or feedback, neither of which was given by the instructor. Unless relatively brief human interaction is defined as praise, praise was not a factor in this study. Extra credit for higher performance on the exercise also was not a factor, for all Ss received the same amount of extra credit regardless of their performance.

A clue as to why Group I Ss did not perform as well as Group II Ss comes from observations made by the CBT instructor. It seemed that Group I Ss used the space bar more frequently than did Group II Ss. In this study's tutorial, Ss had the capability to literally space-bar their way through the tutorial. That is, rather than actually performing the requested tutorial action, Ss could depress the space bar and step through the program. Although not measured, Group I Ss (no interaction) seemed to take this approach more frequently. Consequently, although both groups were equally exposed to the material, Group II Ss (interaction) seemed to actually perform the steps of the tutorial more often. If in fact Group II Ss did spend more time-on-task, the space bar behavior could account for the difference in achievement. The difference in standard deviation between the two groups could also be a result of the differing amounts of actual time-on-task.

Although the small number of cases in this study prevents anything more than a reporting of the following, it was noted that there appeared to be an interaction between group (interaction/no interaction) and spreadsheet experience level (high/low). In general, Ss with previous experience in using a spreadsheet performed roughly the same across instructor interaction levels. However, low-experience Ss who interacted with the instructor scored higher than did low-experience Ss who did not interact with the instructor. Also, low-experience/no-interaction Ss appeared to be the students who more frequently used the space bar to sequence through the tutorial and consequently spent less time-on-task.

This observation is generally in keeping with other research which has suggested that high-skill-level students benefit more from CBT than do low-skill students, at least in moderate to high complexity tasks (Adams, Waldrop, Justen, & McCrosky, 1987; Hativa & Shorer, 1989; Klein & Keller, 1990; Whitney & Urquhart, 1990). High-skill students may be in less need of teacher support. Regardless of teacher interaction, these students are capable of doing the tutorial and do so without need of monitoring or encouragement. On the other hand, low-skill students may have greater difficulty interacting with the computer and/or the tutorial and therefore may be the ones who require increased human interaction—both to get started and to stay on task.

If the explanations offered above are accurate, they suggest that brief human interaction serves to keep students on task more so than no human interaction. Also, if I am a low-skill/experience student and either do not know what to do or encounter a problem in the CBT courseware, I will probably not seek assistance. Instead, I will try to get through the exercise as quietly as possible (e.g., by using the space bar). However, if I know that a teacher is going to be initiating interactions with me and is therefore going to be aware of how well or how poorly I am doing, then I may try to stay on task more.

Due to the manner in which the Group II interactions occurred, instructor monitoring of the students was confounded with interaction. For the instructor to know when to interact with an appropriate comment, the instructor had to know when a student was approaching a particular point in the tutorial. In order to know this, the instructor had to constantly monitor the students' progress. Consequently, while the Group I instructor sat at a desk and waited for students to request assistance, the Group II instructor was constantly walking around the room and visually checking on where Ss were in the tutorial. Therefore, it may be that monitoring, and not interaction, was the basis for Group II's higher achievement.

These results add to the results reported by Moore (1988), who found that CBT instructors with positive attitudes produced higher achievement than did CBT instructors with negative attitudes. Evidently, instructor interaction can also affect achievement. Whether or not the interaction needs to be tied to course content is unknown. It may be that CBT instructors should interact with students in order to maximize achievement, but the interactions may not need to be related to the material being covered.

V. IMPLICATIONS

The relatively short-term nature of the tutorial used in this experiment obviously limits the generalization of the present results. That limitation not withstanding, the specific conclusion obtained is that brief instructor-initiated interactions can increase achievement in CBT. However, instructor monitoring without interaction may produce the same result.

It may also be true that the CBT instructor can most influence group achievement most by spending relatively more time with low-skill students. Skill could be defined by, for example, selection scores (Scholastic Aptitude Test, Grade Point Average, proficiency test, etc.) or by initial student performance on the CBT program. Therefore, CBT instructors need to be able to identify those students with low ability/aptitude so that relatively more time can be allocated to them early in the course.

Because the role of the instructor in CBT is frequently undefined, the present results give some direction as to what a CBT instructor can do to influence achievement. Moreover, because instructor-initiated interactions are controlled by the instructor, these interactions should also be built into the larger learning system. For example, in addition to being included in the CBT courseware, they should also become part of the instructor evaluation system.

The major implication from the present investigation is that instructor interaction does seem to influence achiement in CBT. The results obviously support Moore's research (1988) and McCombs (1984) suggestions. There is simply something about having another human around and aware of your actions that alters your behavior. Even in the best-designed, best-built, and best-implemented CBT systems, instructor behavior may still influence achievement. Rather than trying to design a CBT system which does away with the instructor (or to design a system which essentially ignores the instructor), CBT developers should try to find ways in which to use instructor presence to maximize achievement.

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